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REPORT OF

FIFTIETH ANNUAL

DATE GROWERS'
INSTITUTE

Held in

COACHELLA VALLEY, CALIFORNIA

March 2, 1973



VOLUME 50

PUBLISHED BY THE DATE GROWERS' INSTITUTE

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Chairman of Session:

ROBBINS RUSSELL

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The Date Growers' Institute is the official educational organization of the date industry. It was organized in 1924 for the purpose of developing a literature on date growing, handling, marketing and research and of disseminating this knowledge among growers and other persons. Membership in the Institute has been open to growers and other interested persons and companies. Members pay dues, and a price is charged for the annual report — to defray costs of publication and mailing. The current dues and prices are as follows:

Individual membership	annual dues, \$10.00
Company membership	annual dues, \$25.00
Annual Report, price per copy	\$3.00
Complete set, Vol. 1-50	\$75.00

Members receive a free copy of the current annual report, and all copies are mailed postage free.

Information on membership or the purchase of annual reports may be obtained from:

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INTRODUCTION

Robbins Russell¹⁾

As you are aware, this is the 50th annual session of the Date Growers' Institute. Inexorably, time has taken its toll. Of all those on the program of the initial session, about 50 years ago, only two remain. So, though I am no longer personally, or officially, connected with our date industry, it fell to me to appear today. I emphasize that this gives me real pleasure. But because of my disassociation with all present industry activities, my brief remarks are confined to the historical past.

First, a word on the annually published Date Institute proceedings. When Dr. H. J. Webber, then Director of the Citrus Experiment Station, University of California, and Chairman of that first meeting of our Date Institute in February 1924, outlined the need for, and the opportunity in annually publishing our Institute proceedings, I suspect that even he did not foresee the excellent results now available in these publications. As original source material for the industry, they are unsurpassed. And when, on April 7, 1927, by formal resolution of the fourth annual Institute, the publication of the proceedings of each year's session, — in standardized pamphlet form — was authorized retroactively, including the first session, Dr. Webber's recommendation was made a reality. Although the standard of the various papers varies over the years — as is understandable from their varying authorship — they have one outstanding recommendation: they are honest, current expressions of their authors.

Perhaps a chief criticism of the reports, taken as a whole, lies in the abbreviated role assigned to the historical phase of our industry. One seldom recalls now that as late as 1900, trees bearing edible fruit in the U. S. were almost entirely monoecious dicotyledons, namely, deciduous trees, herbs and shrubs. Almost the only edible date fruit produced locally came from chance pollination of a seedling of *Phoenix dactylifera*. Some early-in-the-century efforts were made to develop uniform, commercially desirable dates. This was by using the offshoots of desirable parents. It was soon recognized, however, that this would take many generations to obtain sound commercial plantings. It became obvious that a commercial date industry domestically had to be based on imported nursery stock which had already passed through many generations of selection.

Looking forward from about 1900, this decision to seek the foundation stock for American production in overseas sources, posed formidable problems to our pioneer growers and their advisors. Such questions as the following had to be answered:

— Where could good date nursery stock be obtained?

¹⁾ Participant in the first Date Growers' Institute, February 29 and March 1, 1924, then President of Valley Packing Association and a date garden manager, participant in many later Institute annual meetings and also was President of Coachella Valley Date Growers Association.

— Which of the established foreign varieties should be transplanted?

— How could these living offshoots be shipped such long distances?

— Where in the U.S.A. would fruit production be most likely to succeed?

— And, basic to this program, how could the costs be financed?

From today's outlook we pass over these and hosts of similar questions quickly. But at the start of this century such questions were baffling and the answers harsh. Pains-taking study produced answers involving considerable hazard. But because of this study and, let's face it, outright guesswork, our industry came to its present maturity.

Before closing my preliminary statement I will mention some who, with scores of their associates, were prominent in these

'birth throes' of our present California Date Industry. In so doing I stress that the list is very brief and includes only those no longer living, almost all of whom I knew personally.

There were Doctors W. T. Swingle, Vinson, Fairchild, Mason, Kearney and Forbes, and Messrs. F. O. Popenoe, T. J. Gridley, C. E. Cook, W. L. Paul and Bernard Johnson, along with so many others who contributed to what we have today. Inasmuch as Dr. Hilgeman of the University of Arizona has made a good, detailed report on the rise and fall of the Arizona date industry (49th annual report of the Date Growers' Institute, pages 11 through 14), I purposely omitted reference to the interesting work in that state from about 1890 on.

We now take up the formal program, with my thanks to you for indulging me in these reminiscences.

Future Date Acreage

D. H. Mitchell¹⁾

No other tree crop resembles the date palm in its early non-bearing years, its partial bearing period, its period of full production, and in its removal. Usually the first five years are almost non-productive and the next five are of varying production depending on the policy of the grower. Should he decide to remove all offshoots he will be in good production much sooner than if he decides to let them mature. His cost in offshoots is substantial, since growing them postpones full production of dates.

From ten years to thirty years the palm is in full bearing and the grower should have his most profitable years. The palms continue to produce well beyond that age but costs of production mount.

Records on file at the office of the Date Administrative Committee show that over 350 acres are past their 50th birthday. These palms are very tall, indeed, but most are still being cropped. Other palms not as old have been removed.

It is significant to note that more than half of the palms in our Valley are over 35 years old. This means that about 2,000 acres will have to be planted in the next 15 years to maintain our present acreage. It also means that to do this, returns to the grower must be kept at a profitable level.

Looking back at the records we find that there were very few years indeed when as many as 100 acres of offshoots were set out. We expect our industry to do more than stay the same size, we look for expansion. To do so we must all conserve offshoots and not shoot for early heavy production. Offshoots when sold should return their costs to the grower.

¹⁾ Date producer and ranch manager.

Local growers have been most cooperative when asked to give me estimates on the number of Deglet Noor, Zahidi and Medjool offshoots to be available for planting in the next three years. These figures are not actual counts but they should be reasonably close:

	1973	1974	1975
	number of available offshoots		
Deglet Noor	5,300	2,200	3,650
Zahidi	2,500	1,200	1,000
Medjool	2,500	1,000	2,000

No attempt has been made to determine the available males but it is certain that every good quality male should be salvaged and maintained. It should be pointed out that the trend to using "ground rigs" for spray pollination of palms means the need for larger quantities of pollen than were needed for hand pollination.

Minor varieties are important to the welfare of the industry and should be kept in production, though in a limited way. The high-class fruit stores and date shops with their mixed packs of dates for gifts, are most useful in introducing dates to the public. Such fine varieties as Khadrawy, Halawi, Barhi, the black varieties and many others must never be allowed to disappear as varieties. Unfortunately, some valuable varieties now have no offshoots with which to continue production.

All Coachella Valley growers, particularly those of the future, owe a debt to Dr. J. R. Furr and his scientific co-worker Roy W. Nixon, for the years of work and effort they put into the cross breeding project that is now well on its way. However, they are now retired, there has been a reduction of funds for the program, and we could find that all the efforts to date will be lost

or only partially developed. I am sure that the members of the Date Administrative Committee are concerned about whether the efforts to develop new varieties of superior quality, or varieties with fewer faults, will be carried through to their conclusion. Since they are the logical agency to pursue this, we must all aid them in all ways possible. It's truly important.

In 1959 W. W. Cook made a report to the Date Institute calling attention to the fact that more acres of dates were going out of production than were being planted. Considerable new planting was done during the early sixties. In 1969 when Mr. Cook made another report we had kept the acreage at the same level. We need a survey at least every ten years. Quick adjustment of acreage to markets just cannot be done due to the nature of the date palm. New plantings must be anticipated well in ad-

vance and overplantings corrected, should they occur.

As a final thought I would like to suggest that a careful inventory be made of all date palms in our Valley but on a basis of palms rather than acres. As our palms get tall we have more and more "skips." Strong winds will topple palms, lightning or fire will take out others, and some just fall down for no apparent reason. Production records should be adjusted to the palm count anyway, so why not go all the way and not translate palm count to acres? It would be simpler to have just one way of measurement.

With our present better marketing system, improved mechanization, and a chance to replace tall palms with young ones, optimism about the future seems justified. Let's look ahead for the Date Institute Report of 1983 and see how things came out!

Mechanical Pollination of Date Palms

R. M. Perkins¹⁾ and P. F. Burkner²⁾

Introduction

Mechanization work in date production began in 1961 with the mechanical harvest research program. By 1965 this program was completed with nearly 75% of the fruit being harvested mechanically. The required labor force for harvesting had been reduced from nearly 900 men to about 250 men (1), (2). This large reduction in the harvest labor force requirements resulted in the peak requirement shifting to pollination. With the termination of the bracero program it was imperative that this peak labor requirement be reduced to the point where it was in balance with the harvesting labor. All other cultural operations could be completed with a labor force of approximately 200 men, whereas pollination required nearly 700 men during the peak period.

In the summer of 1965 the first development work on a mechanical method for the pollination of date palms was begun. The two primary objectives of this program were, one, to make a large reduction in the peak labor requirement and, two, to try to reduce the overall pollinating cost.

Aerial Application Trials, 1966

In the spring of 1966 the first experimental mechanical pollination was tried (3). Twelve one-acre plots were established, and these were pollinated by aircraft. These plots were broken into two groups, one to be flown by fixed-wing aircraft with conventional dusting gear and the second to be flown with a helicopter employing special metering and application equipment that we developed for pollinating.

Various rates and frequencies of application were established for both methods,

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these ranged from a low of one quart of pollen per acre per season applied every four days to a high of three quarts of pollen per acre per season applied every two days.

The helicopter was set up so that two rows could be done at each pass. A narrow band of pollen was ejected from tubes below the helicopter into the crown area of each row of palms. The conventional dusting equipment used on the fixed-wing aircraft employed a broadcast method in which a swath of pollen about 45 feet wide was applied to two rows of palms. Flour was used as a carrier with the conventional dusting equipment in order to achieve uniform distribution of the small amount of pollen being applied.

All plots were flown between March 17 and May 19, 1966, on their respective schedule of 2 or 4-day intervals except when wind conditions would not allow proper application.

After pollination was completed, each plot was thinned in three different methods, no thinning, center cutting of strands only, and normal thinning by center and end cutting of strands.

When the fruit was harvested in the fall, it was apparent that the helicopter had reduced results superior to that of the fixed-wing aircraft. Total yield with the fixed wings was between 40 and 60% of hand pollinated checks. The helicopter applications had resulted in yields of 70 to 120% of hand pollinated checks. Much of the difference in yield could be attributed to the helicopter's higher concentration of pollen in the narrow band of the palms' bloom area.

Differences between the 4 and 2-day application schedule and 1 and 3-quart rates showed that a 2-day schedule applying three quarts of pollen would be only slightly better than either a 4-day schedule applying three quarts of pollen or a 2-day schedule applying one quart of pollen. This indicated that the frequency was more critical than the volume of pollen applied.

Aerial Application Trials, 1967

The spring of 1967 found the industry facing an acute shortage of labor. Because the previous year's results with the helicopter had been promising, a commercial-scale program involving nearly 500 acres was established for 1967. This was broken into two blocks of 250 acres each to be flown on alternate days.

Since a shortage of pollen was anticipated if a 3-quart rate of application was used, a compromise schedule of a 2-day frequency and 1.5 quarts of pollen/acre/season was selected. Pollination started on the 10th of March and ran through the 15th of May. During this time, several periods of wind were experienced which would not allow pollinating by the helicopter. In most cases these did not last over 2 to 5 days. Since the helicopter could cover nearly 100 acres/hour, it was possible to cover all of the acreage in one day when the wind did stop. Operation of the system seemed very favorable.

The total cost of the pollination was \$35 per acre, plus pollen, which was considerably lower than by hand. Also, the labor replacement was very high since two men in a helicopter replaced 50 tree men.

When the harvest season commenced in the fall of 1967 it was apparent that the results were not equal to hand pollination yields nor to the results of the 1966 tests. Yields ranged from 20 to 50% of hand pollinated yields.

A survey of all the factors which could affect the fruit set and yield was made. The most significant difference which could be determined was between the daily maximum temperatures for 1966 and 1967. A study of the weather records maintained for the Coachella Valley since 1906 by the U. S. Weather Bureau and the U. S. Date and Citrus Station showed that 1966 had been one of the warmest spring seasons on record while 1967 had been the coldest on record. (4)

Since most growers had covered the pollinated blooms with liquor bags during the hand pollination in 1967, there was very little reduction in hand pollinated yield due to poor fruit set. Previous work by Reuther had shown that the liquor bags could raise the temperature of the bloom by as much as 15° F. above ambient conditions. (5)

Further analysis of weather records indicated that a cold spring might occur once in every ten years. Since the helicopter pollination system had produced very poor yields during cold weather, this program was dropped.

Studies of pollen germination and viability had indicated a correlation with temperature. It was felt that a higher concentration of pollen in the bloom area would improve pollination even in cold years.

Ground Level Application

In 1968 the first ground-level application was tested with a trailer-mounted palm duster. (6) The duster operator stood on a fixed-height platform 12 feet above the ground level and directed a delivery pipe at the bloom area of the palm. The delivery

pipe was counterbalanced and gimbal-mounted in the floor of the platform for ease of operation. The pipe, within the operator's reach, was 3-inch PVC plastic for electrical safety. The upper portion beyond the operator's reach was 2-inch aluminum irrigation pipe topped by a 3/4-inch nozzle for light weight and rigidity. The dusting nozzle was about 30 feet above the ground level. A roots-type blower provided 125 CFM of air to propel a pollen-flour mixture through the nozzle at about 450 mph. Since dusting material cannot be conveyed through this type of blower (as normally done in vane axial fans) it was necessary to meter the pollen mixture into the pressurized airstream from an airtight hopper. The design of this hopper was similar to the one developed for the helicopter applications.

This system was used on about two acres of palms on the Valley Center Ranch. Palm heights on this ranch varied considerably and the distance from ground level to the bloom area varied from 32 to 48 feet.

Applications were made on a twice-weekly basis from March 26 to May 3, 1968, applying three quarts of pollen per acre per season.

Results of pollination with the palm duster showed that fruit set of the tall palms was much poorer (approximately 1 inch strand/pollinated fruit) than those of the medium to short palms (.6 to .7 inch strand/pollinated fruit). This indicated the need for a variable-height platform in order to adjust to varying tree heights. Grower returns for the palm duster had been nearly equal to those of the hand pollination, \$28.89/palm for the palm duster vs. \$30.20/palm for the hand pollination, even though the total fruit production had been less, due to increased quality with the mechanical system.

In 1969, a redesigned palm duster was put in the field employing a variable-height platform. This was accomplished by mounting a forklift mast to a trailer, which gave 15 feet of vertical travel. The air supply and delivery tube systems were similar to those used on the 1968 machine. This machine was used on plot work on the La Quinta Ranch for the 1969 and 1970 seasons. Results from these two years were similar to those of 1968 on short and medium-height palms. Various rates and frequencies of application were tried on different plots. The conclusion was reached that 1.5 quarts of pollen/acre/season would be a sufficient quantity of pollen, and that once-a-week application would work if bunches were properly thinned.

In 1971 the palm duster was used by a grower to pollinate approximately six acres with his own field crew. This gave us a chance to evaluate the machine's performance under more typical field conditions using the same type of labor that would be used if it were to be applied commercially. Again the results were favorable and comparable to those that had been achieved in the previous year's test.

In 1972 a full-scale commercial test was proposed in which the capacity and capability of the system would be tested. For this test 62.5 acres were chosen from five co-operative growers located in five different areas of the valley. An operating crew was recruited from local labor and the machine

was put into operation on March 10, 1972. Applications were made once weekly, applying pollen to both sides of the palm. The rate of application was scheduled to be 1.5 quarts of pollen/acre/season based on 7 to 8 applications. Due to the relatively short pollinating season, only six applications were made and 1.2 quarts of pollen applied. Pollen was mixed with "Wondra" flour at the rate of 1 part pollen to 11 parts flour. Wind delayed application in some cases, with the longest period between applications being 9 days. Distance between gardens was a maximum of 15 miles, making moving time between gardens a major factor.

All bunches were thinned after pollination was completed. On two of the five gardens, thinning and tie-down were completed as a single operation. In the other three gardens thinning was done as soon as possible after completion of pollination and tie-down was done as a separate operation. No apparent problems were experienced by doing both thinning and tie-down together and this resulted in a lower overall cost for both operations.

The overall results of the experiment were very encouraging. It was possible to cover 62 acres with little problem with the weather. This acreage could be expanded to 80 acres if the gardens were close together and the crew would work six days a week. When the gross returns to the grower were compared, the average of all mechanical (\$942.00 per acre) exceeded that of the hand checks (\$881.00 per acre) by \$61.00 per acre (weighted aver-

age of individual gardens taken from Table 1), based on receiving grade slips and present payment schedules.

Even though the total fruit set was less with the mechanical system (.88 inches/pollinated fruit) than that of hand pollination (.799 inches/pollinated fruit), the difference in size and quality of mechanically pollinated dates offset these differences. The fruit set on both the mechanically and hand pollinated block was somewhat lower than the average of the previous year's test.

The entire valley experienced a reduction in the number of bunches per palm. Previous years' tests had shown an average count of from 16 to 18 bunches per palm, whereas the 1971-72 average of all gardens in the test was only 12.5.

The system has been accepted by the industry and six machines are presently being built for use this spring. If each machine is used to capacity it would be possible to mechanically pollinate approximately 15% of the total acreage this year.

The machine as designed has the additional feature of being convertible to a pesticide duster. This allows a much greater use of the machine (hours of operation/year), which reduces its fixed cost per hour. Evaluation of the effectiveness of the machine as a duster has shown it to be superior to conventional dusters. Less than 1% mite and infestation have resulted, with an overall reduction in the quantity of dusting material required. The machine is capable of dusting on a regular schedule from 200 to 250 acres per season.

Table 1. Results of 1971-72 Mechanical Pollination Tests.

Garden	Treat.	Net yield /acre*	% Poll.	Ave. No. bunches /palm	Gross returns \$/acre*
Sungold	Mech.	9,550	93.5	12.7	768.50
	Hand	7,300	96.3	10.5	555.00
Narbonne	Mech.	12,950	94.7	13.3	1,233.50
	Hand	11,100	98.8	13.2	1,017.50
Fairacres	Mech.	11,600	94.2	12.6	1,020.00
	Hand	10,900	97.4	13.3	1,083.50
Parker Ranch	Mech.	10,500	94.5	12.0	1,014.50
	Hand	10,400	92.8	12.7	846.00
Valley Center	Mech.	9,550	93.7	13.0	797.00**
	Hand	10,350	99.4	12.2	902.50

* Net yields and gross returns per acre based on 50 palms per acre.

** Returns adjusted for difference in mite damage between hand and mechanical treatments.

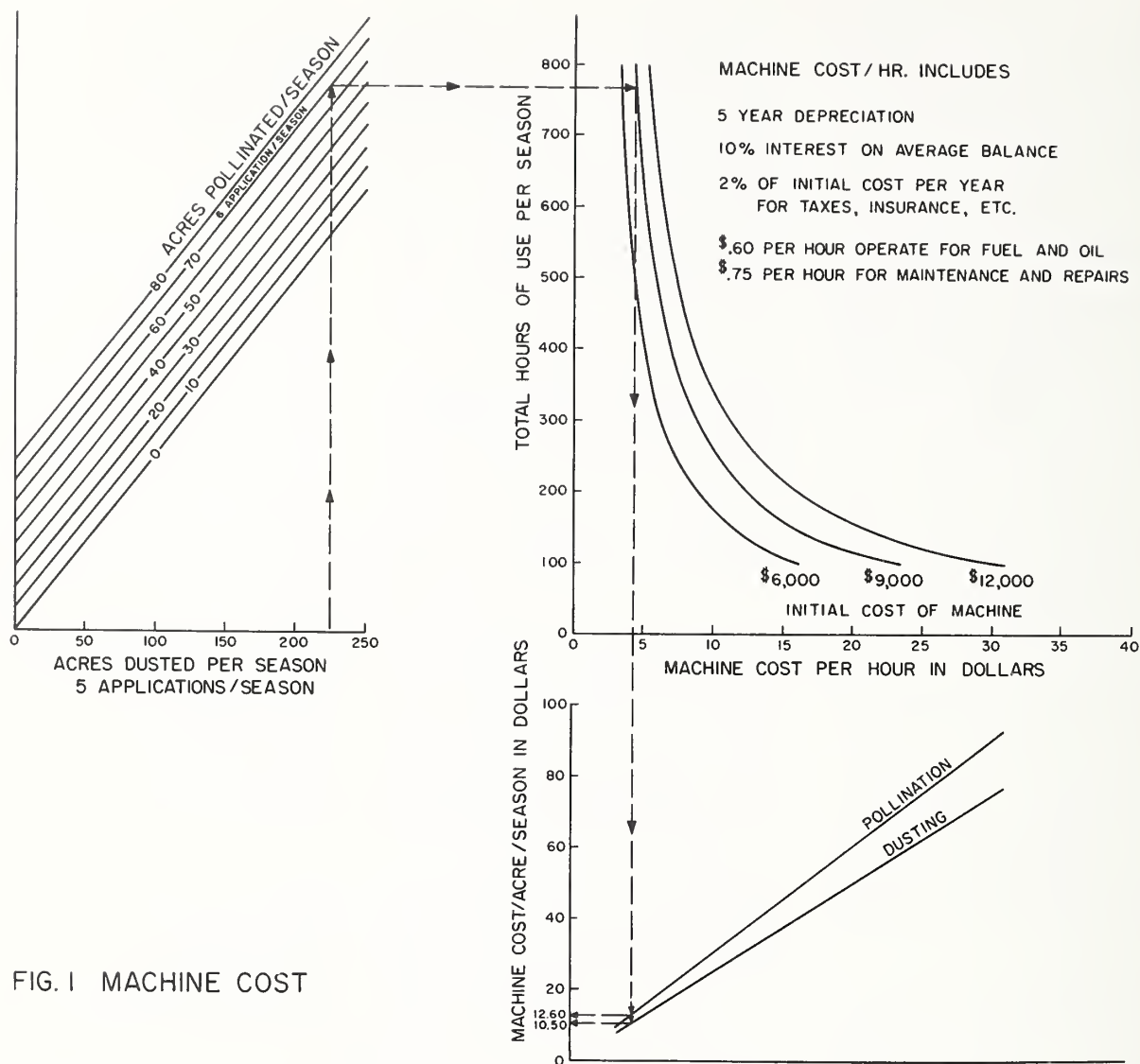


FIG. 1 MACHINE COST

Machine Cost

Figure 1 shows machine cost per acre per season for various combinations of acreage pollinated and dusted per season. The assumption is made that the machine can pollinate up to 80 acres per season and maintain a once-weekly schedule if the gardens are reasonably close together. It also can be used as an insecticide duster on up to 250 acres and maintain a normal dusting schedule.

To compute machine cost for both pollination and dusting, we enter the chart vertically from the number of acres dusted per season, going up to the diagonal line for the number of acres pollinated per season. A horizontal line is drawn from this intersection to the appropriate line representing initial machine cost. The Y axis of the graph shows the total number of hours per season the machine will be used. From the intersection of the horizontal line and the initial machine cost line, a vertical line is drawn down to the diagonal line for pollination and dusting. From this intersection a horizontal line is drawn to the machine cost axis. This will give the total machine cost

per season per acre for each operation, based on the total number of acres done by the machine.

To figure the total cost we must add the cost of labor (2 men) and a tractor, plus supervisory labor if necessary.

Since all of these costs will vary from grower to grower, we will not attempt to establish these costs in this text.

To make a complete cost estimate, the following parameter can be used. For pollination, with 6 applications per season, there must be added to the total machine cost 3 hours tractor time per acre per season and 6 man-hours of labor per acre per season. When the machine is used for dusting, making 5 applications per season, there must be added to the total machine cost 2.5 hours of tractor time per acre per season and 5 man-hours of labor per acre per season.

If we follow through on the example shown using 70 acres/season pollination and 225 acres/season dusting, we find the total machine cost to be \$12.60 and \$10.50, respectively. If we figure the tractor time at \$3.00 per hour and labor at \$3.00 per

hour, we find a total cost of \$39.60 per hour for pollination and \$23.00 for dusting. These are direct costs only and do not include the cost of pollen, flour, pesticides or supervision.

With the cost of hand pollination at nearly \$100.00 per acre, the comparison between methods is very favorable.

Conclusions

An acceptable mechanical pollination system is now available. The cost of the system is favorable, and the labor replacement is satisfactory. Two men on the machine can replace four to six tree men doing hand pollination. The operator and tractor driver need not be experienced tree men, thereby expanding the present labor force available for pollinating.

The machine as designed has the dual capability of being both a pollination unit and a pesticide duster. Results of four years' use as a pesticide duster show that reductions can be made in both infestation and mite damage if the proper schedule is maintained, with a reduction in the total

Pectic Enzymes and their Application in the Quality Improvement of Mixed Green Dates

Dora C. Smolensky, Wynn R. Raymond and V. P. Maier¹)

Introduction

A large number of dates harvested during the 1972 season exhibited a ripening disorder which affected about 46% of the crop. This problem was referred to our laboratory by the date industry.

The affected dates, designated "mixed green", had a greenish-brown color and when observed in cross section, the inner tissue appeared white and firm. They had a crunchy, "grassy" flavor and the moisture level was about 25-26%. Since the slight

green color did not seem to be much of a problem, we concentrated on improving the texture.

The texture of all fruits is determined to a large degree by the presence of pectic substances and cellulose fibers. We have demonstrated in the past the presence of two hydrolytic enzymes in the date, polygalacturonase (1) and cellulase (2), which cause degradation of those substances, thus contributing to the softening of date tissue. Hobson (3), who investigated softening in tomatoes, suggested in 1964 that there was a positive correlation between ripening (loss of firmness and color development) and increased polygalacturonase and pectinesterase activity. He also concluded that cellulase may complement the action of pectinesterase and polygalacturonase, but flesh softening is primarily controlled by the pectic enzyme complex. It was also previously shown that the "sugar wall" problem in dates could be solved by spraying with invertase (4).

In view of this information we decided to use different combinations of cellulase and pectic enzymes to try to improve the textural quality of the "mixed green" dates. This paper reports the results obtained with these enzymes.

Materials and Methods

The "mixed green" dates were supplied by Cal-Date Company, Indio, California. Cellulase was obtained from Sigma Laboratories, St. Louis, Missouri; Pectinol 42-E, from Rohm and Haas Laboratories, Philadelphia, Pennsylvania; Klerzyme 200, from Wallerstein Laboratories, Morton Grove, Illinois; and Spark-L, from Miles Laboratories, Elkhart, Indiana. The sprayer used consisted of an atomizer top attached to a 250-ml. Erlenmeyer-type reservoir.

Unpitted Deglet Noor dates ("mixed green") were allowed to dry over a weekend at room temperature in single layers in order to avoid spoilage due to high moisture content. Samples of 50 dates were then treated by spraying with the following:

- I. H₂O
- II. Cellulase (0.1%)
- III. Cellulase (0.05%)
- IV. Cellulase (0.05%) plus Pectinol 42-E (0.05%)
- V. Pectinol 42-E (0.1%)
- VI. Klerzyme 200 (0.09 ml/liter)
- VII. Spark-L (0.1%, 0.5% and 1.0%)

Pectinol 42-E is a food-grade pectic enzyme preparation high in pectinesterase ac-

tivity and polygalacturonase activity but relatively low in polymethyl-polygalacturonase activity (5). Klerzyme 200 is a pectinase preparation used to hydrolyze the pectin in fruit juices (6). It is low in pectinesterase (5). Spark-L is a new food-grade pectinase preparation; no information about its composition was available.

The spraying method was simple and could be applied to either whole or pitted fruit. The outer surface of the fruit was sprayed thoroughly with a diluted solution of the enzymes. After spraying, the small amount of free surface liquid was allowed to drain off for about an hour and the fruit were stored in closed containers at the desired temperatures. The dates were observed by three people and evaluated subjectively for flavor and textural quality.

Results

Examining cross sections of individual dates, treated at 75° F and 100° F, we observed that most of the dates which had been treated with H₂O only were still tough after 24 hours, (Table I). Dates from treatments II-V softened considerably, II and IV to the point of being mushy. Treatment III, using a lower level of cellulase alone, and treatment V resulted in an acceptable level of softening. Color and flavor in treatments III and V improved, closely resembling that of a "natural" date. Dates treated with Klerzyme 200 showed no softening after 24 hours, but did show a small degree of softening after 42 hours. Optimum temperature for Spark-L was 140° F, which is too high for dates, but we did achieve some softening with concentrations of 0.5% and 1.0% at 100° F after several days.

Table I. Effect of Various Hydrolytic Enzymes on the Texture of "Mixed Green" Dates.

Enzyme Treatment	Softness After 24 Hrs. At Either 75° or 100° F
I. Water Control	Tr.
II. Cellulase (0.1%)	+++
III. Cellulase (0.05%)	++
IV. Cellulase (0.05%) + Pectinol 42-E (0.05%)	+++
V. Pectinol 42-E (0.1%)	++
VI. Klerzyme 200 (0.09 ml/liter)	Tr.
VII. Spark-L (0.1%)	—
Spark-L (0.5%)	Tr.
Spark-L (1.0%)	+

— = no change

Tr. = slightly softened

+

++ = softness approaching that of a "natural" date

+++ = overly softened (loss of structural integrity)

• Mechanical Pollination (Continued)

amount of material applied. Operators have shown a marked preference for the new, improved duster over the conventional dusting machines.

Two factors have helped to promote the present acceptance of the machine, one, increasing cost of hand pollination and, two, the generally poorer hand pollination that has been experienced in recent years due to the shortage of labor. The number of rounds made in hand pollination has been reduced from a high of seven when the bracos were available to the present 2 to 3 rounds, which has resulted in a decrease in fruit set for hand pollination.

It is not our intent that these machines should be used to replace existing labor. They should be used only to fill the void created by the lack of labor. Hopefully, they will allow a balanced year-round labor force to be used in all date cultural operations.

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Since industrial interest in Spark-L had been expressed, Spark-L was compared with a second "food grade" pectinase preparation (Pectinol 42-E) and a water control sample for consumer acceptance as follows: Three samples of "mixed green" dates, one treated with Pectinol 42-E (0.1%), a second with Spark-L (0.5%) and the third with water as above, were presented to a panel of 19 people who were asked (1) to indicate which sample had the softest texture, and (2) based on prior knowledge of the industrial criteria used for assigning market grades to dates, to choose the sample having the greatest market appeal (i. e. that sample most closely exhibiting the quality characteristics of a "waxy" or "natural" date). The results are shown in Table II.

Table II. Preference shown by Panel for "Mixed Green" Dates treated with two Food Grade Pectic Enzymes.

	Preference ^o	
	Softness ^{oo}	Market Appeal
H ₂ O	4	5
Pectinol 42-E (0.1%)	11	11
Spark-L (0.5%)	3	3

^oFigures denote number of panelists preferring treatment

^{oo}One panelist was unable to detect a difference between H₂O and Pectinol 42-E. This response was not included in the table.

Discussion

The best results with food grade pectinase preparations were obtained with Pectinol 42-E, which worked considerably faster than the other enzyme preparations used. The difference between Pectinol 42-E and the other preparations is its high pectinesterase content (5). It is possible that other enzyme preparations high in pectinesterase content would be effective in improving texture of "mixed green" dates.

The cellulase used also was very successful, either alone or in combination with Pectinol 42-E. The particular cellulase used for this study was a purified enzyme and not a food grade preparation. Hence we did not use it for taste panel studies. However, the effects of food grade cellulase preparations on tough dates are now being studied in our laboratory and will be reported elsewhere.

Since three types of treatments were submitted to the panel for evaluation, the probability of any one treatment being selected by chance alone was 33%. The fact that 61% of the panelists chose the Pectinol 42-E-treated sample is very significant and indicates that the application of added Pectinol 42-E can improve not only textural quality of "mixed green" dates but enhances other desirable marketing characteristics as well.

Comments made by members of the panel were very favorable as to the texture and flavor of the dates, supporting further the above conclusion.

We conclude that price permitting, Pectinol 42-E spray treatments can be used as an effective means of upgrading significantly the quality of dates such as the "mixed green" grade which exhibit textural and other immaturity defects.

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Fumigation of Field Run and Processed Dates with Aluminum Phosphide and Methyl Bromide

Howard D. Nelson¹), David L. Lindgren²) and Lloyd E. Vincent³)

Laboratory studies showed that field-run and processed Deglet Noor dates fumigated with aluminum phosphide (Phostoxin) at dosage rates of 10, 20 and 30 tablets per 1,000 cu. ft. for six days did not alter the odor, flavor or appearance of the dates.

Field studies in which field-run Deglet Noor dates fumigated in stacks covered with polyethylene sheeting with aluminum phosphide at the rates of 5, 10, 20 and 30 tab-

lets per 1,000 cu. ft. for six days killed all of the test insects with the exception of those in one stack. That stack was one of three fumigated at the rate of 5 tablets/M cu. ft. and the survival was caused by loss of fumigant due to punctures in the plastic covering. Test insects included Indian meal moth eggs, larvae and pupae; dried fruit beetle larvae, pupae and adults as well as merchant grain beetle adults. No detectable aluminum phosphide residue was present on the fumigated dates.

Field-run Deglet Noor dates fumigated one time and 2, 3 and 4 repeat exposures in the laboratory with methyl bromide applied at the rate of 1 lb. per 1,000 cu. ft. for 12 and 24 hours contained inorganic bromide residues. There was a gradual increase in the amount of inorganic bromide present as a result of length of exposure time and

repeat fumigations. The amount of inorganic residue ranged from 8.7-43.3 ppm. The Federal inorganic bromide tolerance for dates is 125 ppm.

EDITOR: A complete paper on this subject has yet to be prepared. However, Howard Nelson did use the above abstract to give the Date Growers' Institute the benefit of this recent research. In elaboration, aluminum phosphide, available in tablet form under the trade name Phostoxin, generates the gas hydrogen phosphide (also called phosphene). The tablet turns to gas within five days and by the sixth day was found to have killed all test insects. The test was made on Deglet Noor dates under a 6-mil polyethylene cover held down by sand snakes. The conclusion is that usage of a minimum of 10 tablets per 1,000 cubic feet will assure a complete kill of infestation by the end of the sixth day.

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Where Does the Coachella Weather Come From and How is it Changing?

Carl J. Garczynski¹⁾

Basically the major part of our weather comes from the west or off the Eastern Pacific and it is changing.

If one were to ask me, "Where does our weather originate?", that would be extremely difficult to answer. The weather in the prevailing westerlies, normally found in mid-latitudes, is a continuous circle around the Northern Hemisphere and as it travels from west to east it is constantly being modified. It can be either heated or cooled or have moisture extracted or injected. The more westerly it remains in direction the less it is modified and the more near normal is our weather. But this is not always the case. Small and large scale perturbations occur quite frequently within these westerlies, giving us some changes from the normal.

If you would, please picture a west wind aloft coming from the mid-Pacific and flowing into Southern California. This is the normal or mean situation. This mean is similar to the mean of a sine-curve function with its ridges and troughs, or if you wish perturbations. Of course, the wind perturbations are not quite as smooth. Some are extremely large, others relatively small (long and short waves), in their coverage of longitude and latitude. A short wave may only be 200-300 miles wide and affect the weather over a relatively small area. These short waves frequently move within longer waves, which may be covering the entire Eastern Pacific or the 48 contiguous states.

Normally, we associate fair weather skies with a ridge and foul weather with troughs. Let us imagine that upper-level wind, again, in the mid-Pacific. This time let it flow north into the Gulf of Alaska, then curve east toward British Columbia and then southeast into the Central United States. This long wave ridge pattern will bring high barometric pressure to the Eastern Pacific and far Western States, and therefore, fair weather skies of a prolonged nature. In contrast, imagine a wind at mid-Pacific heading southeast to subtropical latitudes, warmer water, more surface evaporation, and therefore more moisture to be picked up and transported by the wind as it curves northeast into the Southwestern United States. This would be a long trough resulting in foul weather for much of the Southwest and again of a prolonged nature.

As you might imagine, a short wave with no function within longer waves, would be associated with shorter periods of fair or foul weather.

Both the long and short waves have a slow progression eastward, considerably slower than the wind speed within them. Some may pass in several hours (short waves), others may take weeks (long waves). They also change in intensity and configuration. Here is where some of our forecast difficulties lie. For instance, if that wind we tracked into the Gulf of Alaska were to move inland into the Yukon Territory before curving south, it would have

been cooled and dried considerably. It would have gone over usually colder land and had its moisture extracted while passing over the various mountain ranges before reaching us. If this were to occur in winter, we would have a severe freeze situation. This was the case last December and January. Another "back door" extreme, which usually results in heavy rains, would be a southerly flow carrying warm, moist subtropical air northward from the Gulf of California or the Baja Coast. Rarely would this upper-level flow come from due east.

From this brief discussion you may have already gathered that any time our upper-level wind flow has a strong westerly component, the more apt we are to have near normal conditions. Whereas, with a north to northeast component or south to south-east component, look out!

Keep in mind that all this has been taking place within the prevailing westerlies. But these westerlies have a tendency to migrate with the seasons, being found more north in the summer and farther south in the winter. You notice the change by the fact that we have more frequent frontal passages in the winter when we are well into the westerlies. Whereas in the summer we have more stagnant conditions when we are on the extreme southern fringes of the westerlies. Along with this migration there is also a migration of two semi-permanent surface features, the Pacific High and Sonora Low. The Pacific High meanders over the Eastern Pacific adjacent to the West Coast, and the Sonora Low over Northern Mexico and the Southwestern U. S. Both of these systems migrate in conjunction with the prevailing westerlies. The Pacific High serving as a shield to locations to its east while the Sonora Low intensifies the instability over the southwest in the summer.

One reason I have chosen the upper-level to illustrate where our weather comes from is to show the direct relationship between the upper air and surface weather. What forecasters refer to as vertical consistence. And would you not say it's an extremely difficult task to say where our weather originates? But we could say with a reasonable amount of confidence, that it is coming from upstream.

Yes, the large scale circulation is changing. But no appreciable change has been observed in the relatively short time that we have been probing the atmosphere. The changes are occurring in conjunction with the constant evolution of the Earth. And as minute as the large scale changes of the Earth are, so too are the changes of its atmosphere.

Most atmospheric scientists agree that we are in a cooling cycle. With the mean world temperature having decreased by nearly 0.3°F in the past 25 years. Much of this drop can be attributed to man and his activities. Although on a smaller or microscale such as the Coachella Valley, these changes are more evident but again relatively small.

Let us examine a few of the Valley's weather elements a bit more closely and

their changes. Wind usually blows from high to low pressure. And cool air is usually associated with higher pressure than warm air. So we essentially have wind blowing from a cooler surface to a warmer surface. Such as ocean to desert in the spring and summer when the land is absorbing more heat. And land to sea in fall and winter when the water is warmed as a result of its heat retention capabilities. The greater the temperature differences, the stronger the pressure gradient, the stronger the wind. And because of our relationship to the coastal mountains, where the air is restricted as it travels inland, our winds are a bit stronger than the pressure gradient can justify. On the other hand an offshore flow or a Santa Ana wind condition gives us less wind than the pressure gradient warrants, because of less restrictions to the east. And of course, we have our winds associated with the passage of weather systems of which the worse is low pressure over Southern Nevada in the spring, which would assist the natural on-shore flow that time of the year and make it even stronger. This is the main reason our windy season occurs in the spring. And with the passage of high pressure in the fall and winter to aid the offshore flow, we observe a stronger Santa Ana wind which is named after the Santa Ana River, where these winds blow the strongest. As you can see, temperature, pressure and wind are directly related. So any changes in one of these elements will result in a change in the other two.

Our temperature is not only a function of sunlight, but also of the type of surface and atmospheric composition. I am sure we all agree that these two have changed and are changing within the Coachella Valley. The surface is mainly being converted into more vegetation, which is resulting in some cooling, hardly detectable, except in the immediate area. But as our vegetation expands, we should anticipate some measurable cooling of daytime temperatures and some warming at night. For along with the vegetation expansion there will be more evaporation and in turn more moisture in the air to help retain some of the day's heat. That's a change we might all enjoy, provided it's not enough moisture to hinder date production. Another added advantage of more vegetation would be a noticeable reduction in blowing dust and sand. The additional humidity caused by this expansion would probably be in the neighborhood of 1-2%. Daily maximum temperatures would possibly cool by as much as 2-3°F, while minimum temperatures would probably show the same amount of warming, thus the mean temperature would not change. So I would doubt that any large-scale vegetation expansion would be harmful to agriculture.

But what about air pollution? How is it affecting the temperatures? Or the other weather elements? Air pollutants have caused an increase in the annual temperature of 2-3 degrees over large industrial areas, while over rural areas it is presently unmeasurable. The main pollutant that affects

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Marketing the Algerian and Tunisian Deglet Noor Date Crop

Kenneth Patterson¹⁾

According to Algerian and Tunisian tradition, the Deglet Noor variety was started by an Arab date grower who lived in the town of El Oued in Algeria, near the Tunisian border. This grower had a few young seedling palms in his back yard. He particularly watched one of them because it looked a little different from his other palms. When it finally came into production, he found the fruit had some of the characteristics of both the bread dates and the soft dates he was growing in his date garden. He realized that it was superior to either one of them and the Deglet Noor soon came to be recognized as an exceptional variety. This is generally believed to have happened about 300 to 350 years ago, although several people in Tunisia insisted it was as recent as 150 years. In any case, Deglet Noors really came into their own and plantings expanded rapidly when the French became involved. At the present time nothing but Deglets are being planted to any extent in either Algeria or Tunisia.

Until recently, practically all sales of North African Deglets, other than for domestic consumption, have been handled by the French date packers in Marseille. The French government took over Algeria in 1830. The first Deglet Noors exported were sent to Bordeaux, France, by a French army officer stationed in southern Algeria and named Champagne. The officer's family

presented them to various officials and heads of government throughout Europe. They had immediate requests for more and were soon in business with the first dates being packed in Bordeaux. Shortly afterwards the young industry moved to Marseille, which is only a 24-hour trip across the Mediterranean from the ports of Skikda, Algeria and Tunis, Tunisia.

The French packers developed markets in most of the European countries. Outside of Algeria and Tunisia, where the variety originated and where dates are eaten like we eat bread and potatoes, France is the largest per capita consumer of Deglet Noor dates in the world. One of the French packers started gardens of his own in Algeria and all of the largest plantings in both Algeria and Tunisia came to be owned by French interests. The French drilled the first artesian wells in North Africa where an inadequate water supply is one of the biggest production problems. They also introduced the idea of uniform spacing between palms and used growing techniques most suitable to the conditions that prevailed. This was the situation for many years during which time extensive Deglet Noor plantings were made and the French handlers continued to develop more markets.

Things started to change drastically during 1956 in Tunisia and 1962 in Algeria, when these countries rebelled against French control and obtained their independence. Along with most other French interests the date gardens were expropriated by the new governments. The justification used by the Algerians was that the French had used and profited from the lands for over 100 years. They were originally taken away without any compensation and now the Arabs were taking them back the same way. On the other hand, the French feel they were robbed of producing properties that had been developed out of otherwise useless desert land.

I spent two weeks in Algeria and Tunisia and another week in Marseille, France, during December, 1972 and January, 1973. All the information in this report is based strictly on what I observed and was told by various people while there. Also, I double-checked everything with Charles Bijaoui, a native of Tunisia, who has spent most of his life working with one of the French handlers — buying, packing and selling Algerian and Tunisian dates — and is an acknowledged authority. At this point I would like to say I was treated very well everywhere and like visiting royalty on some occasions. The Algerian office of fruits and vegetables provided me with a car and guide for a four-day trip south to the packing plants and gardens at Biskra and Tolga and I was accompanied by the Chief of the Department of Dates from Algiers. The Tunisians gave me a five-day trip to Gafsa, Tozeur, and Nefta in the southern part of the country. The only problem I had the

entire time was a complete lack of any knowledge of the French language. English is spoken very little outside the cities and it was necessary to have a translator along much of the time.

Since independence, Algeria has become a very socialistic country which now wants to handle its own business and grow, pack and sell its products under the O.F.L.A. label. O.F.L.A. stands for Office des Fruits et Legumes d'Algerie, which is a government monopoly that markets all fruit and vegetable exports as well as much of the domestic consumption. Seven modern packing plants have been built with more than enough capacity to pack the Deglet Noor crop, which now amounts to about 40,000,000 pounds of marketable dates annually. These plants were built after independence with the help of the French government's foreign aid program. The French government was pressured into financing and building these plants, because of the need for Algerian petroleum on which France is dependent. The Algerian government also bought out one of the largest French packers (Dattes J. Lavagne, S. A.) in Marseille primarily as a marketing organization to handle its European sales and as a training school for Algerian personnel in processing and packing Deglet Noor dates, using French methods.

The Algerians have been reasonably successful in learning to operate the packing plants, but their sales efforts have been weak outside their own country. This past season they successfully shipped some dates into the German market, but another 6,000,000 pounds did not arrive in France until December 10th, which was too late for holiday distribution. Thousands and thousands of cases of all sizes of packaged dates were on the docks in Marseille, and cold storages there were jammed with them. Despite these problems, the Algerians were not alarmed and their date growers were happy. The grower prices were far above what the dates actually returned. All the government revenue goes into one pool and the money from oil and gas royalties is used to help pay off the farmers.

One problem seriously concerns the larger Arab growers and that is the Algerian government's agrarian reform program. Under this policy each grower would own a maximum of 100 trees. The feeling is that the gardens would not be cared for and quality and productivity would decline as it has in the old oases, where many palms yield less than 50 pounds. There are sharp differences of opinion among the Algerians on the subject of agrarian reform. It has not yet been put into effect so far as dates are concerned, but is coming, unless there is a change in policy.

Since it achieved independence in 1956, the situation has been different in Tunisia. At first there was quite a leaning to socialism, but in the past few years the trend has been toward more private business. A large part of the Tunisian Deglet Noor

• Coachella Weather (Continued)

the temperature is carbon dioxide, which absorbs heat in much the same manner as water vapor. One consolation, the added vegetation will probably absorb much of this additional carbon dioxide. Don't misunderstand me, air pollution will modify our climate and it is doing it at a much faster pace than Mother Nature intended. Let us not rush her.

The Coachella Valley's air pollution will become acute within the near future and the climatic changes will become measurable. Our pollution problems have the potential of being much worse than that of the Los Angeles Basin. The topography of the Valley, the abundance of sunshine which is essential for photochemical smog, and the consistent presence of a relatively strong temperature inversion, all add up to trouble as far as air pollution is concerned.

I hope this little talk has helped you in your understanding of the workings of the weather. We have seen that most of our weather comes from upstream and that our weather is changing minutely, although a bit faster than Mother Nature intended, with the help of man.

But I don't believe our pollution problems are as gloomy as they may seem. If we wanted to we could stop pollution tomorrow and any problem that can be solved tomorrow can't be so bad.

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date crop is handled by STIL (Societe Tunisienne De L'Industrie Laitiere) in Tunis. This organization is a diversified fruit, vegetable and dairy operation. It grows, packs, cans and sells many food items. Its 2,000 acre date garden at Tozeur in southern Tunisia is well cared for. Much of it is young plantings that will be coming into production within three or four years. STIL has two packing plants in Tunis. Besides STIL's own gardens, which are the largest, there are many other substantial Tunisian growers. Other than for domestic consumption, these dates are mostly sold to the French handlers. There are 15,000,000 pounds of marketable Deglet Noor produced in Tunisia annually, with an increase coming in the next few years. There is more young date acreage in Tunisia than in Algeria. Much of the money to finance these hundreds of acres of young Deglet Noor plantings comes from the World Bank, which has been making forty-year loans on new date gardens. The Tunisian industry has to stand on its own two feet economically, since there is no oil money to support it. Apparently it is doing so — with the cooperation of the French packers — as the industry seems to be prospering and expanding.

In 1971, the five French date packers in Marseille formed a buying organization called EuropDatte. This is a purchasing combine through which the handlers buy dates wherever they can obtain them, including the United States. The five members of EuropDatte have packed and sold about 30,000,000 pounds of dates per year for many years. When they were cut off from Algerian supplies, they began to purchase Deglet Noors from the United States and Halawis from Iraq, so that their total volume has not declined. One result of the lack of supplies from Algeria has been that the French have started to introduce Halawis into some of the European markets, where they had never been sold before. These are at a lower price than Deglet Noor, which can hurt the price structure, particularly in Germany, where the largest

volume is being sold. Also, most the members of EuropDatte are beginning to add dried fruits and nuts to their line, which is giving them more strength in the market.

Sales and distribution of dates out of Marseille to the European trade is very similar to sales of this country. Some sales are direct to larger buyers, but many are through brokers or agents. While there are still numerous independent stores throughout Europe, most of the business is done with large chains and with the co-ops, which are strong in Scandinavia. In most European countries dates are available everywhere, especially during the fall months, and coverage of the consumer market is more complete than we have been able to accomplish in the United States. European consumers seem to have more brand loyalty than they have in this country, and each of the EuropDatte members has his brand well established in certain areas.

The biggest selling item in Europe is the layered, nine-ounce, glove pack. Hundreds of women were busy at the date plants in Algeria, Tunisia and Marseille, making up empty packing boats in readiness for the next season's crop. Labor costs make that type of package prohibitive in this country. Even with their relatively low wage rates, however, there is a changing trend to more economical packaging. All the packing lines were not operating in the Algerian plants but they are equipped with modern machinery to handle form-and-fill cellophane bags and eight and 14-ounce overwrapped trays. Also they put out two-pound and three-pound gift packs in large volume. Most gift boxes are packed with natural dates still attached to the stems or branchettes. This is a very popular item.

Wholesale prices of 225 gram trays destined for West Germany seem to be about the same, whether they are f.o.b. Los Angeles, Algiers or Marseille. Last fall's prices ranged from 19 to 23 cents per package. Even though their costs are low, the Algerians are not cheap sellers during the fall. They have a tendency to set the opening

price too high. Then they have to bail out in the spring at distressed prices, because the entire crop has not been sold. The French are in much better control of their business. They set prices and use promotional programs that keep merchandise moving in order to create the maximum return by the end of the year. The basic difference is a lack of experience by the new Algerian regime, plus the fact that oil revenues will pick up the tab if they don't sell the date crop. The French and the Tunisians have nothing to make up their losses, so they try hard not to incur any. Even though dates are one of the main staples in Algeria and Tunisia, the Deglet Noor variety is considered to be an expensive food. In the cheapest ghetto retail markets in Algiers, natural Deglet Noor dates sell from 30 to 35 cents per pound. Dry Deglet Noors range from 20 to 25 cents per pound and the common varieties are about 15 cents per pound.

It appears very likely that sooner or later the Algerians will resolve their marketing problems and regain at least a portion of the European consumer pack business. They are looking for increased sales volume and are bound to do better as they improve their methods. This could hurt U. S. exports of consumer packs into northern Europe, although it should not affect our other export markets. So far as the bulk business on dry dates to EuropDatte is concerned, there are good indications that this country will have an outlet there for quite some time to come, although the volume could vary from year to year. The reason for this is that California Deglet Noors are generally a little drier and seem to carry over the summer in cold storage better than the more moist North African dates. The California dates give the Marseille handlers a lead on the market and all are packed and sold by the time the first North African, new crop Deglets arrive in the latter part of October. It is unlikely that the Algerians or Tunisians will establish themselves in the U. S. market at any time in the foreseeable future.

Date Palm Research and Culture in Morocco, with Special Reference to Bayoud Disease^{1) 2)}

J. B. Carpenter³⁾

Summary

Date palm research in Morocco is directed towards control of the bayoud disease, incited by *Fusarium oxysporum* f. s. *albedinis*, through selection, breeding and distribution of bayoud-resistant varieties. Personnel of USDA cooperate informally in the breeding portion of the program. Methods for rapid propagation by small offshoots of the date palm are being studied. The date palm research is part of a vigorous

integrated program to improve Moroccan oasis agriculture.

In October 1972, I visited several areas of southeastern Morocco, where the date palm (*Phoenix dactylifera* L.) is grown. I observed the date palm research program conducted jointly by the Moroccan Ministry of Agriculture and Agrarian Reform and the French National Institute of Agronomic Research (2, 3, 5). Further observations (1) were made on the devastating bayoud disease, incited by *Fusarium oxysporum* Schlecht. f. s. *albedinis* (Kill. & Maire)

Malencon, which was first noted about 1870 in Morocco. By 1950 (4) an estimated 10,000,000 palms had been destroyed by bayoud in Morocco. The current census of live palms lists 4,500,000, of which the greater part are in the southeastern ones.

Field Diagnosis of Bayoud

Research workers in Morocco and Algeria took special pains to show me typical and unusual expressions of bayoud in many different situations to enable me to make field diagnoses with improving reliability. Bayoud has never been seen in date palms in the United States, but those charged with date palm research should be able to recognize the disease.

¹⁾ Grateful acknowledgement is made to Monsieur Georges Toutain, Chef de la Station Centrale de Recherches sur le Palmier-Dattier, Marrakech, and to Monsieur H. Faraj, Directeur-General, Direction de la Recherche Agronomique, Rabat, for their generous assistance and hospitality.

²⁾ This travel was made possible by the cooperation of the Ford Foundation, which collaborated with the Algerian Ministry of Agriculture and Agrarian Reform in convening the Bayoud Workshop-Seminar in Algeria, to which I was a delegate, and which preceded the Moroccan trip.

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Pathogen and Inoculation Studies

The existence of strains of *Fusarium oxysporum* f. s. *albedinis* is being investigated cooperatively by G. Toutain in Morocco, and J. Louvet, National Institute of Agronomic Research, Dijon, France. They are searching also for more effective and rapid methods of inoculation of date palms and of testing for disease resistance to the bayoud pathogen. At present, field tests of resistance are made in heavily-infested ground and can be completed in about five years. Artificial infection has been successful only with seedlings less than one year old. The development of rapid and reliable methods of inoculation and infection of older plants would greatly accelerate the breeding and selection of new hybrids, as well as the screening of local, apparently bayoud resistant candidate palms.

Selection and Testing Program for

Bayoud Resistance

Extensive, well-planned, and replicated field tests are under way at Zagora to test the resistance of date palms to bayoud. The plots are planted to Bou Feggous, a susceptible variety; Iklane, a highly resistant variety, and candidate varieties selected in bayoud-infested plantings. On the basis of these and earlier tests, about 10 resistant female varieties of diverse quality have been selected for study and field use.

More than 3,000 male and female palms of either varietal or seedling origin and growing in active foci of bayoud are under field observation. Offshoots from the best of these will be subjected to experimental infection trials. Most of the candidate varieties are of Moroccan origin. A few are under test from Algeria, notably Takerboucht, a commercial bayoud-resistant variety; Tunisia, four varieties; and Mauretania, one variety. This cooperative aspect of the bayoud work is encouraging.

Breeding Program

Date palm breeding to obtain bayoud-resistant varieties with fruit of high quality suitable for export and domestic has just begun. The fine varieties Medjool and Bou Feggous, which were formerly the basis of an active export trade in dates to Europe, are highly susceptible to bayoud and have been severely reduced in numbers. Bayoud-resistant male palms now available will be used to hybridize with these and other superior female varieties. Good, resistant female varieties will be crossed with local resistant males and also, as pollen becomes available, with advanced back-crossed males from the Indio Station. Within 8 to 12 years some useful hybrids should be expected, if reasonably large populations of seedlings are raised.

Hybrid seed produced by using pollen from advanced back-crosses of male palms at Indio have been planted at Zagora; the one-year-old plants are flourishing. Hopefully, some of the seedling male palms will prove tolerant enough to bayoud to provide pollen for the Moroccan breeding program.

Accelerated Propagation:

A primary problem in vegetative multiplication of date palms is the current obligatory, slow propagation by offshoots, which weigh at least 10 to 15 kg. At Marrakesh, mist propagation has been used successfully in rooting of small offshoots weighing 1 kg. or more. Even under improvised conditions, rooting of 90% or more of small offshoots has been accomplished. This suggests that conservation of water by the offshoot, rather than the amount of reserve food, is perhaps the governing factor in survival of small offshoots during the rooting period. Improved facilities are planned to pursue this vital work, which has direct implications in the development of both bayoud-resistant varieties and others of high quality. Rapid propagation by small offshoots would speed up the testing of both male and female varieties and the production of planting stock for date growers.

At Zagora, field tests are being made on propagation by small offshoots of four date varieties, in three sizes (3-5, 5-7 and 7-10 kg.), planted at various depths, and subjected to three different water schedules. These tests, though less than one year old, show promise of giving useful information about a field-based program of accelerated propagation.

Attempts are being made to stimulate dormant vegetative buds to produce offshoots on bearing palms. In one test, boxes of moist earth are placed around the palm trunks at a height of about 1.5 meters, and in another test moist earth is held to a height of about 1 meter around the bases of the palms by means of a closely woven fence. A few young palms with perhaps two feet of trunk have been sprayed with ethrel, in the hope that the chemical will depress terminal growth and stimulate production of offshoots.

This work on propagation is of great interest, since the development of a rapid means for the propagation of selected palms would be of value to the breeder and to the date grower. Some valuable selections and varieties produce only a few offshoots, although presumably palms derived from either seed or offshoots have potentially viable vegetative buds in most of the axils of the first 75 or more of the basal leaves that are produced before the onset of annual flowering.

Date-fruit Handling

I visited the date cooperative at Zagora. Fruit of the soft Jihel variety was being packed for shipment to Casablanca. The fruit was handled several times, was not very clean, and was placed by hand into about 8-oz. packages, which were packed into 8-kg. cartons for shipment.

At the Tabouassant Station near Erfoud, the bayoud-resistant, semi-dry variety Bouslicene was being harvested. These were the best dates seen in bulk. The fruit was clean and neatly handled. The palms were yielding at least 50 to 60 kg. and were under good culture. In the Ziz Valley, at Aoufous,

I enjoyed Medjool dates of fine quality. Reportedly, about 14,000 to 15,000 Medjool palms still survive, but some bearing trees are lost every year to bayoud, along with all of their offshoots.

Integrated Oasis Agriculture:

The date palm work is a vital part of an integrated agricultural program developed by the Moroccan Ministry of Agriculture and Agrarian Reform. In the southeastern oases, family farm holdings average about 1 ha. net. A model unit of this size is being studied as a family property that would provide subsistence and cash income.

The 1-ha. units are planted to resistant palms at a regular spacing of about 10x10 m., rather than the traditional random cluster planting, well described as "anarchique." The area under the palms is devoted one-third to forage, usually alfalfa; one-third to subsistence vegetables; and one-third to a cash crop, frequently henna. The three areas are rotated and, with a few supplementary fruit trees and other plants, offer a rational and economic use of the land. Some growers are reported to be using the system; if they are successful, their example should help to convert others from the traditional and wasteful methods in current use. With the exception of some basic land leveling that is done with heavy machinery, the labor practices used on the demonstration areas at Zagora and at other experiment stations in the same zone are those that the local growers can use on their own farms. The demonstration areas are impressive and offer real hope for rehabilitation of oasis agriculture.

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International Cooperation in Research on Date Palm Culture

Andrew W. Watson¹⁾

The story of the date palm and its culture can be divided into four eras, the last of which we are just entering. The first of these is the *Prehistoric* era. During this period, beginning several million years ago and extending to the time several thousand years ago when *Homo sapiens* began to affect wild populations of date palm, the species *Phoenix dactylifera* L. evolved from some progenitor *Phoenix* palm. This is postulated to have occurred somewhere between the Euphrates and the Nile, probably in what is now southern Iraq. Subsequently a wild population of this species, having the general botanical characteristics which are recognized today as those of the date palm, *Phoenix dactylifera*, became established in this region and spread naturally to a limited and undetermined extent. This era closed when *Homo sapiens* discovered the utility of the palm.

The second era covers the period of early man's utilization of and influence on the date palm. Initially man merely gathered dates from wild trees, where they were growing, but later he would probably have carried seeds with him to plant in new areas. Thus early man first assisted in the distribution of the wild-type population of date palms. At a later time some selection of the type of seed planted would have been practiced; date palms grown from seed taken from palms of high-yielding characteristics would tend to yield like the mother plants. In this way man exerted selected pressure upon the species and enriched the population with higher yielding individuals. It was about this time that the Sumerian civilization evolved in the Tigris-Euphrates area. It is generally postulated that the domestication of grains was the key factor in building sufficient food surpluses to permit the organization of urban communities. But I wonder if the date palm was not the real and primary catalyst of the whole process; the conspicuously-useful, easily-planted, relatively-permanent and simply-cultivated date palm would provide food surpluses and subsequently grains might have been developed as subadjacent crops, growing under the palms. Certainly in many of these regions today the bulk of the food is provided by the date, while grains are grown under the palms and are of secondary importance. Sometime during the Sumerian and Egyptian agricultural civilization, vegetative propagation of dates was discovered. Superior seedlings of different areas were observed and many true horticultural varieties were selected and multiplied. I strongly suspect that the date palm was among the first plants to be improved by seedling selection and also among the first for which varieties were established and propagated.

The third era sees the development of the date as a cash crop, the application of modern technology in its culture and the spread of the date palm from the Old World. The United States and particularly the USDA date and citrus research station at Indio has been a major influence in this era. Though dates have been grown for only a very short time in the U. S., nevertheless the bulk of the technology of date culture comes from California. During this era most of the research and development has been on cash crop dates of superior varieties in favorable growing areas; subsistence or consumption culture of dates, especially in areas less suited for dates, has been largely neglected.

In the last few years we have moved into the era of international cooperation in research on date palm culture. The FAO appointed a date specialist to examine not only cash crop dates, but also the condition of subsistence crop dates in all countries where they are important. FAO date surveys have been carried out in Pakistan, Morocco, Iran and in most of the Old World date growing countries attempting to bring improvements to date culture. The same teams have examined the feasibility of establishing date culture in new areas such as East Africa. Periodic meetings are held to bring together specialists in date culture from all countries to exchange ideas and results. One such meeting is scheduled to be held in Iraq in November of this year.

The International Division of Food Machinery and Chemical Corporation has been carrying out surveys of date growing areas which at present do not have a major cash crop. The aim is to develop the date production of these areas into a major cash crop and a foundation for the development of the people of these regions.

Some of the major problems and threats to date palm culture are now being tackled on an international basis. A classical case is the problem of the Bayoud disease caused by *Fusarium oxysporum* Schlecht. f. sp. *albidenis*. (Kill. & Maire), Malencon. This disease originated, and/or was first observed, in Morocco in the last century. It has spread steadily east since then and it has now infected the oases of Western Algeria and threatens the major commercial plantings of Deglet Noor in the east of the country. The Algerian government asked the Ford Foundation for assistance; the Ford Foundation began an international program to utilize the best available scientific information to design a plan to prevent the further spread of the disease eastward into the cash crops and to reconstitute the already infected areas. Professor W. C. Snyder of the University of California at Berkeley, the world authority on *Fusarium* diseases, played a major role in organizing the Foundation's efforts.

In October 1972 an International Seminar on Bayoud was held in Algeria attended by scientists from nine countries. A program was planned which the attending scientists agreed would have the best chance of combatting the disease. At the Seminar, an International Council of Bayoud Research was established, whose aim is to foster further communication on an international level between Bayoud researchers. (Anyone interested in receiving the newsletter of the council or wishing to contribute should write to me or Professor W. C. Snyder.)

At the same meeting the desirability of establishing a World Date Research Council was discussed. Here the date palm could be considered as an international crop and its problems tackled without regard to national or ethnic boundaries.

At present, work on the Bayoud disease inspired by the Seminar and directed by ICBR is being carried out in England, France, Italy, Algeria, Morocco and the U. S. A. One of the most interesting research projects under way is the search for a rapid method for propagation of date palms by using tissue culture techniques. Work in California by Schroeder and by Oppenheimer and Reuveni in Israel has indicated some of the problems to be met in this work. It is hoped that these can be overcome with the techniques developed particularly for ornamental plants. Research on rapid propagation of date palms is being carried out in the laboratories of a California plant propagating company.

The date palm has a significant past in the cradle of civilization. I believe it has a significant future which can be realized through international cooperation. Thousands of years ago men of different origins must have shared the fruit and the shade of a single palm in the desert. Hopefully the same palms can motivate a new spirit of international cooperation for the benefit of both men and palm.

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